HUAWEI

RAN

Iu Flex Parameter Description

Issue 01

Date 2009-03-30

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About This Document

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Contents

1 Change History

The change history provides information on the changes in different document versions.

Document and Product Versions

Table 1-1 Document and product versions

Document Version	RAN Version
01 (2009-03-30)	11.0
Draft (2009-03-10)	11.0
Draft (2009-01-15)	11.0

This document is based on the BSC6810 and 3900 series NodeBs.

The available time of each feature is subject to the RAN product roadmap.

There are two types of changes, which are defined as follows:

- Feature change: refers to the change in the Iu Flex feature.
- Editorial change: refers to the change in the information that was inappropriately described or the addition of the information that was not described in the earlier version.

01 (2009-03-30)

This is the document for the first commercial release of RAN11.0.

Compared with draft (2009-03-10), this issue optimizes the description.

Draft (2009-03-10)

This is the second draft of the document for RAN11.0.

Compared with draft (2009-01-15), draft (2009-03-10) optimizes the description.

Draft (2009-01-15)

This is the initial draft of the document for RAN11.0.

Compared with issue 03 (2008-12-30) of RAN10.0, draft (2009-01-15) incorporates the following changes:

Change Type	Feature Description	Parameter Change
Feature change	The description of NNSF timer is added in 3.1.3 NNSF.	The added parameter is as follows: • NNSfTmr
	The description of paging routing process in the PS domain is added in 3.1.3 II Processing of the IMSI Paging Message (PS Domain).	None.
Editorial change:	The description of the LAI and the description of the CN overload are changed. The title of the document is changed from *Iu Flex Description* to *Iu Flex Parameter Description*.	None.

2 Introduction

Before the Iu Flex feature is introduced into the WCDMA network, one RAN node is connected to only one CN node. This network structure brings in great restrictions. Therefore, the Iu Flex is introduced in the R5 by the 3GPP. The Iu Flex enables one RAN node to connect to several CN nodes (SGSN or MSC server), and several CN nodes constitute a pool area. In the same pool area, the UE roams freely without changing the serving CN node.

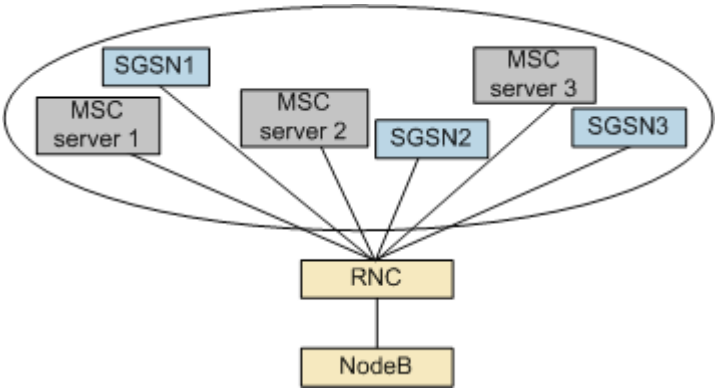
The Iu Flex improves the network performance, enhances the manageability of the network, balances the loading, and reduces the users roaming signaling, and so on.

The Iu Flex has the following functions:

- The total capacity of the CN nodes is expanded, and the signaling load sharing between CN nodes can be balanced.
- The intra-CN-node updates, handovers, and relocations are reduced, and the HLR update traffic is also decreased.

Figure 2-1 shows the Iu Flex topology where one RAN node is connected to multiple CN nodes.

Figure 2-1 Iu Flex topology



Intended Audience

This document is intended for:

- System operators who need a general understanding of Iu Flex feature.
- Personnel working on Huawei products or systems.

Impact

- **Impact on system performance**
  None
- **Impact on other features**
  None

Network Elements Involved

Table 2-1 describes the Network Elements (NEs) involved in the Iu Flex.

Table 2-1 Network elements involved in the Iu Flex

UE	NodeB	RNC	MSC Server	MGW	SGSN	GGSN	HLR
√	–	√	√	–	√	–	–

NOTE:

- –: not involved
- √: Involved

UE = User Equipment, RNC = Radio Network Controller, MSC Server = Mobile Service Switching Center Server, MGW = Media Gateway, SGSN = Serving GPRS Support Node, GGSN = Gateway GPRS Support Node, HLR = Home Location Register.

3 Iu Flex Principles

3.1 Iu Flex Principles

The Iu Flex brings in the concept of "pool area". A pool area contains one or more MSC/SGSN service areas. In a pool area, the UE roams freely without changing the serving CN node. The Iu Flex enables a RAN node to route information to different CN nodes, implementing the load balance among MSCs or SGSNs.

The concepts related to the Iu Flex include: pool area, Network Resource Identifier (NRI), and NAS node selection function (NNSF).

3.1.1 Pool Area

This section describes the pool area, in terms of what it is, and how it is served and configured.

A RAN node service area contains all the cells controlled by the RAN node. A pool area is a collection of one or more RAN node service areas. It is served, in parallel, by one or more CN nodes that share the traffic of this area.

A UE is served by one dedicated CN node in a pool area as long as the UE is under the radio coverage of the pool area. Pool areas can overlap each other. If several overlapping pool areas cover a same RAN node service area, the RAN node service area belongs to these pool areas. The pool areas of the CS domain and those of the PS domain are configured independently with the granularity of RAN node service areas.

In a pool area, the UE roams freely without changing the serving CN node. The RAN node service area can belong to the same pool area or several pool areas.

Figure 3-1 shows an example of the pool area configurations.

Figure 3-1 Pool area configuration example

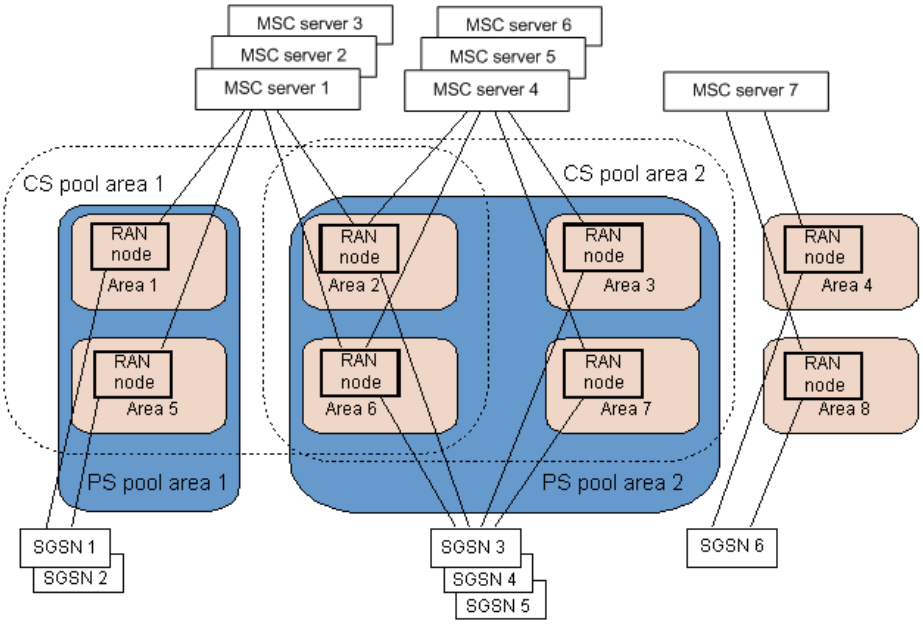


Figure 3-1 shows the following four pool areas:

- CS pool area 1: includes RAN node areas 1, 2, 5, 6, and MSC servers 1, 2, and 3, which provide service for the RAN node areas.
- CS pool area 2: includes RAN node areas 2, 3, 6, 7, and MSC servers 4, 5, and 6, which provide service for the RAN node areas.
- PS pool area 1: includes RAN node areas 1 and 5, and SGSNs 1 and 2, which provide service for the RAN node areas.
- PS pool area 2: includes RAN node areas 2, 3, 6, 7, and SGSN 3, 4, and 5, which provide service for the RAN node areas.

NOTE

As shown in Figure 3-1, the pool areas without the Iu Flex, such as RAN node areas 4 and 8, may coexist with the pool areas with the Iu Flex.

The pool areas of the CS and PS domains can be configured as identical pool areas, such as CS pool area 2 and PS pool area 2, or different pool areas, such as CS pool area 1 and PS pool area 1.

Each pool area has its unique configuration of the CN node capability or number.

3.1.2 NRI

The Network Resource Identifier (NRI) identifies the CN node that serves a pool area. The NRI has a flexible length from 1 bits to 10 bits. The NRI lengths are the same for all the CN nodes in one pool area.

In areas where pool areas overlap, the NRI identifies the CN node that serves these overlapping pool areas. For overlapping pool areas, the NRI

lengths must be configured the same for all the nodes serving specific pool areas.

The CN nodes in the CS domain and those in the PS domain are addressed separately, so the NRIs of the CS and PS domains are independent of each other.

One or more NRIs can be assigned to a CN node.

The parameters related to the NRI are as follows:

- Length of PS NRI (binary): **PSNRILength**
- Length of CS NRI (binary): **CSNRILength**
- Network resource identity: **NRI**

The NRI is a part of the Temporary Mobile Station Identity (TMSI) for the CS domain, or of the Packet TMSI (P-TMSI) for the PS domain. The NRI is assigned to the UE by the serving CN node. The TMSI or P-TMSI allocation mechanism of the CN node generates TMSIs or P-TMSIs with NRIs determined by certain bits.

The association between the NRIs and the CN nodes in the CN pool area is configured on the RAN nodes.

In the WCDMA system, the UE provides an intra domain NAS node selector (IDNNS) in the access stratum (AS) part of the Initial Direct Transfer message to the RAN node. The IDNNS contains a routing parameter with a fixed length of 10 bits. This routing parameter transports the NRI value. In addition, the IDNNS contains the identity of the routing parameters origin. The identity of the routing parameter can be TMSI, international mobile subscriber identity (IMSI), international mobile equipment identity (IMEI), and so on. The RAN node masks the significant bits out of the routing parameter part of the IDNNS to determine the NRI that is used to identify the relevant CN node. The most significant bit of the NRI corresponds to the most significant bit of the routing parameter in the IDNNS.

3.1.3 NNSF

The NAS node selection function (NNSF) performs the selection of a CN node and the processing of the IMSI Paging Message in both the CS and PS domain.

Parameters related to the NNSF are as follows:

- NNSF timer: **NNSfTmr**

NNSfTmr is used in the CS service paging in the Iu Flex.

NOTE

The modification of this parameter has no impact on the equipment.

The setting of NNSfTmr takes effect only when the **CsIuFlexFlag** of **SET IUFLEX** is set to ON or the **PsIuFlexFlag** of **SET IUFLEX** is set to ON.

NNSfTmr is used in IMSI paging, during which the RNC saves the Global CN ID in paging message in the RRC connection; if the RNC receives many paging messages with the Global CN IDs before the NNSfTmr in the RRC connection expires, the RNC saves only the Global CN ID in the first received paging message, and this Global CN ID will not be overwritten by those in paging messages received later; if the NNSfTmr expires, the RRC connection starts the nest NNSfTmr, and the new Global CN ID received will overwrite those saved during last NNSfTmr.

In the RAN node, the NNSF selects a specific CN node (MSC server or SGSN) and routes the initial NAS signaling message to the selected CN node.

If a CN node address configured for the NRI can be derived from the initial NAS signaling message, the NNSF routes the message or frame to the CN node. If no CN node address is configured for the derived NRI or no NRI can be derived (for example, the UE indicates an identity that contains no NRI), or the configured CN node cannot be reached, the NNSF selects an available CN node according to load balancing and routes the message to the selected CN node.

Processing of the IMSI Paging Message (CS Domain)

To increase the success rate of routing the paging response message to the CN node that issues the paging request, the RNC capable of the Iu Flex needs to process the IMSI paging message as follows:

- In R5 protocols or later releases, the Global-CN-ID is contained in the RANAP PAGING message. If the RNC enables the Iu Flex and the paging message contains only the IMSI rather than the TMSI, the paging message must contain the Global-CN-ID.
- The NNSF in the RNC temporarily stores the IMSI and the Global-CN-ID upon reception of the paging message. When the NNSF receives the Initial Direct Transfer message (a paging response with an IMSI), it directly forwards the paging response to the CN node identified by this Global-CN-ID.

If a CS paging message with mobile identity type IMSI is received over the G interface from the MSC, the SGSN has to contain the MSC/VLR-ID in the paging message or paging-request message to the RNC.

Processing of the IMSI Paging Message (PS Domain)

An MS returns an Attach Request containing the IMSI parameter as a response to a PS IMSI paging. Also, a PS IMSI paging is not time supervised from the SGSN sending the message. Therefore, the RAN node receiving such a paging request does not have to buffer the associated SGSN identity. This again means that the NAS Node Selection Function in the RAN node selects an available SGSN (for example, according to load balancing) when it receives an Attach Request containing the IMSI parameter.

The RNC does not have to store the Global-CN-ID when the RNC processes the IMSI paging message received from the PS domain

According to 3GPP TS 23.236, a UE returns an Attach Request message containing the IMSI parameter as a response to the PS IMSI paging. Moreover, the SGSN does not start the timer for the PS IMSI paging after sending the message. Therefore, the NNSF in the RNC does not need to store the SGSN ID when it receives the paging request.

3.2 Iu Flex at the RNC

The process for implementing the Iu Flex at the RNC is as follows:

Step 1 The CN node allocates the routing information to the UE.

Step 2 The UE encodes the routing information to obtain the routing parameter according to the following conditions:

- If the TMSI or P-TMSI is available, the UE preferably obtains the routing parameter through the TMSI or P-TMSI.
- If the TMSI or P-TMSI is unavailable but the IMSI is available, the UE obtains the routing parameter through the IMSI.
- If the TMSI, P-TMSI, and IMSI are unavailable, the UE obtains the routing parameter through the IMEI.

The routing information and encoding mode are saved in the IDNNS and sent to the RNC through the Initial Direct Transfer message. The length of the routing parameter is 10 bits.

Step 3 The RNC selects the route according to the routing parameter derived from the Initial Direct Transfer message.

- If the routing parameter is obtained from the TMSI or P-TMSI, the RNC selects the route according to the NRI.
- The RNC derives the NRI from the routing parameter and then selects a CN node according to the corresponding relationship between the NRIs and the CN nodes. If the NRI is not configured at the RNC, the RNC selects a CN node based on the load balancing. If the routing parameter is obtained from the IMSI, the RNC selects the route according to the IMSIROUTE.

  IMSIROUTE = (IMSI div 10) mod 1000, where "div" means divided by and "mod" means modulus.

  The IMSIROUTE is an integer ranging from 0 to 999.

  The RNC selects the CN node according to the corresponding relationship between the IMSIROUTEs and the CN nodes.

  The IMSIROUTE range of a CN node can be set within the following range: ImsiRtMin to **ImsiRtMax**.

  If the IMSIROUTE of a UE is within the IMSIROUTE range of a CN node, the RNC routes the UE to the CN node.
- If the routing parameter is obtained from the IMEI, the RNC selects the CN node based on the load balancing.

If the routing parameter setting is not obtained from the IMEI, if the NRI is the same as the NullNRI VALUE, the RNC selects the CN node that is

not in the OFFLOAD or INHIBITED state. For detailed information about NullNRI VALUE, see 3.4 "Load Re-Distribution".

The RNC routes the signaling connection message to the selected CN node.

----End

3.3 Load Balancing

Load Balancing describes how the NNSF balances the load between the available CN nodes.

3.3.1 CN Node Capability

The capability of the CN node is of two types:

- Static capability

  The static capability of the CN node is set through the **ADD CNNODE** command.
- Dynamic capability

  The dynamic capability of the CN node means that the CN implements the RNC configuration through the private Information Elements (IEs) of the INFORMATION TRANSFER INDICATION message.

  The dynamic capability reflects the real-time state of the CN node capability.

For the dynamic capability of the CN node, run the SET IUFLEX command to set the parameters **CsInfoUpdFlag** and **PsInfoUpdFlag**. If **CsInfoUpdFlag** or **PsInfoUpdFlag** is set to ON on the basis of the dynamic capability of the CN, the CN informs the RNC of the dynamic capability and state through the private IEs of the INFORMATION TRANSFER INDICATION message. Therefore, the data between the CN and the RNC is synchronized to realize load balancing and optimize network performance.

If the RNC does not receive the message about updating the dynamic capability before the CS Information Update Protection Timer or PS Information Update Protection Timer expires, the static capability is preferred.

NOTE

The Iu interface standard messages INFORMATION TRANSFER INDICATION and INFORMATION TRANSFER CONFIRM contain the extended private IEs. The CN node has to support the extension of the private IEs to inform the RNC of the dynamic capability.

3.3.2 Load Balancing

Load balancing is performed when an appropriate selection of the CN node is made for the UE that is not yet assigned to a CN node.

The RNC selects a CN node from the available CN nodes based on the load balancing principle. Load balancing occurs in one of the following situations:

- There is no CN node configured for the NRI or IMSIROUTE indicated by the UE.
- The CN node corresponding to an NRI or IMSIROUTE cannot be reached.
- The CN node corresponding to an NRI or IMSIROUTE is inhibited.
- No NRI or IMSIROUTE can be derived.
- The value of the NRI is NULLNRI.

According to the load balancing principle, the RNC records the capability of each CN node which is in the NORMAL state, and then selects a CN node for the UE.

The parameter involved is **AvailCap**.

3.3.3 Flow Control

When a CN node is overloaded, the RNC receives the OVERLOAD message from the CN. The RNC then reduces the traffic volume on the CN node. With Iu Flex applied, the RNC needs to select a CN node that is not in the OVERLOAD state by itself when the RNC does not receive the NRI parameter from IDNNS.

For flow control, the CN short-time flow control timer **IgorTmr** and the CN long-time flow control timer **IgorTmr** are configured on the RNC LMT. Note that the **IntrTmr** has to be greater than the **IgorTmr**.

The procedure that gives some degree of signaling flow control is defined as follows:

Step 1 The overloaded CN node sends the OVERLOAD message to the RNC to initiate the flow control procedure;

Step 2 On the RNC side, if the **IgorTmr** is not running and an OVERLOAD message or "Signaling Point Congested" information is received, the traffic volume is reduced by one step. It is also possible, optionally, to indicate the number of steps to reduce the traffic within the Number of Steps IE. At the same time, timers **IgorTmr** and **IntrTmr** have to be started.

Step 3 During the period of **IgorTmr**, all received OVERLOAD messages or "Signaling Point Congested" information is ignored.

Step 4 This step-by-step reduction of the traffic volume is continued until the maximum reduction is obtained at the last step.

Step 5 If the **IntrTmr** expires, the traffic volume is increased by one step and the **IntrTmr** is restarted unless the number of steps by which the traffic volume is reduced is back to zero.

----End

3.4 Load Re-Distribution

Load Re-Distribution provides information on how to re-distribute UE.

There are situations where a network operator needs to remove load from one CN node (for example, to perform scheduled maintenance or load re-distribution to avoid overload), with minimal impact on end users, or additional load on other entities, or both.

3.4.1 Procedure

The re-distribution of UE is initiated by the CN node that is to be offloaded. The procedure of load re-distribution is described as follows:

Step 1 In the first phase (a couple of Periodic LU or RAU periods long), the UEs doing Location Update (LU), Routing Area Update (RAU), or Attach are moved to the other CN nodes in the pool. When the CN node receives the LU, RAU, or Attach request, it returns a new TMSI or P-TMSI with a **NullNRI VALUE**, and a non-broadcast Location Area Identity (LAI) or Routing Area Identity (RAI) in the accept message.

NOTE

NullNRI VALUE is a special value of the NRI, which indicates that the CN node assigned the NRI is to be offloaded. The RAN node (RNC) finds that the NRI is **NullNRI VALUE** and then the RAN node uses load balancing to select another CN node that is identified as NORMAL in the pool. There is one unique **NullNRI VALUE** in a Public Land Mobile Network (PLMN).

- In the CS domain, the non-broadcast LAI will cause the UE to immediately send a new LU request, which the RAN node will then route to a new MSC server due to the **NullNRI VALUE**.
- In the PS domain, a new RAU is triggered by setting the periodic routing area update timer to a sufficiently low value in the accept message. Shortly after that, the UE sends a new RAU request, which the RAN node will then route to a new SGSN due to the **NullNRI VALUE**.

Step 2 In the second phase (PS domain specific), the SGSN requests all UEs trying to set up PDP Contexts to detach and reattach. When they reattach, the SGSN moves them as described in the first phase.

Step 3 The third phase includes scanning the remaining UEs and initiating the movement of them to other CN nodes.

- In the PS domain, the UEs are requested to detach and reattach, which will cause them to be moved.
- In the CS domain, a new TMSI is allocated to the UEs performing the TMSI re-allocation procedure (with **NullNRI VALUE** and non-broadcast LAI) so that an LU is triggered, which will cause them to be moved.

----End

3.4.2 Implementation

The UEs being moved from one CN node are stopped from registering in the same CN node again. The UEs moving into a pool area can also be stopped from registering in a CN node that is overloaded in the same manner.

The RNCs ensure that the movements do not overload the network and the RNCs can handle the situations where several CN nodes are overloaded simultaneously.

When the RNC receives an Initial Direct Transfer message, it uses the NNSF for selecting a CN node to forward the message.

The CN node is one of those whose **CNLoadStatus** is NORMAL. If the NRI is not **NullNRI VALUE**, the RNC can select a CN node in the NORMAL state or OFFLOAD state. The RNC, however, will not select a CN node in INHIBITED state to forward the message.

In network configurations implemented multi-operator core network (MOCN) network sharing, re-distribution is always done between CN nodes within the same CN operator. This is ensured by each CN operator using its own unique NULL NRI. The RAN node is pre-configured with the null-NRIs for different CN operators, and it uses the null-NRI to select a CN node within the same CN operator.

4 Iu Flex Parameters

4.1 Description

Table 4-1 Iu Flex parameter description

Parameter ID	Description
IgorTmr	CN flow control timer (short). The OVERLOAD message received repeatedly in this period will be discarded.
IntrTmr	CN flow control timer (long). If the OVERLOAD message is not received in this period, the traffic volume will be increased by a degree.
CNLoadStatus	The status of the CN node.
NullNRI	NullNRI VALUE indicate that ue assign load other CN node, when NNSF select CN node.
PSNRILength	NRI length for PS domain.
CSNRILength	NRI length for CS domain.
NRI	Identifying a Network resourse. 1. The NRI numbers of CS domain and PS domain are independent from each other. 2. If multiple pool areas overlap, the NRI uniquely identify all the CN nodes connected to it. 3. A CN node can have multiple NRIs. In one pool area, however, an NRI can only correspond to one CN node.
ImsiRtMin	Minimum of IMSI route parameter in IDNNS.
ImsiRtMax	Maximum of IMSI route parameter in IDNNS.
CsInfoUpdFlag	Indicating whether the CS domain permits the CN information to update.

Parameter ID	Description
PsInfoUpdFlag	Indicating whether the PS domain permits the CN information to update.
AvailCap	The Capability of CN node.
NNSfTmr	This parameter specifies the value of the NAS Node Selection Function (NNSF) timer for CS traffic paging. For the IMSI paging of the UE in CS connection mode, on receiving the IMSI paging with the first Global CN ID, the RNC stores the Global CN ID and starts the NNSF protection timer. Once the UE responds to the IMSI paging, the RNC stops the NNSF protection timer.

4.2 Values and Ranges

Table 4-1 Iu Flex parameter values and parameter ranges

Parameter ID	Default Value	GUI Value Range	Actual Value Range	Unit	MML Command	NE
IgorTmr	-	5000~30000	5000~30000	ms	SET IUTIMERANDNUM(Optional)	RNC
IntrTmr	-	15000~1200000	150000~1200000	ms	SET IUTIMERANDNUM(Optional)	RNC
CN	-	NO	NORM	None	ADD CNNODE(Ma	RNC

Parameter ID	Default Value	GUI Value Range	Actual Value Range	Unit	MML Command	NE
LoadStatus		RMAL,OFFLOAD,INHIBITED	AL,OFFLOAD,INHIBITED		ndatory)	
NullNRI	-	0~1023	0~1023	None	SET OPERATORCFGPARA(Optional)	RNC
PSNRILength	-	1~10	1~10	None	SET OPERATORCFGPARA(Mandatory)	RNC
CSNRIL	-	1~10	1~10	None	SET OPERATORCFGPARA(Mandatory)	RNC

Parameter ID	Default Value	GUI Value Range	Actual Value Range	Unit	MML Command	NE
ength						
NRI	-	0~1023	0~1023	None	ADD NRIGLBCNIDMAP(Mandatory)	RNC
ImsiRtMin	-	0~999	0~999	None	ADD IMSIIDNNSCNIDMAP(Mandatory)	RNC
ImsiRtMax	-	0~999	0~999	None	ADD IMSIIDNNSCNIDMAP(Mandatory)	RNC
CsInfoUpdFlag	-	OFF, ON	OFF, ON	None	SET OPERATORCFGPARA(Optional)	RNC
P	-	O	OF	Non	SET	RN

Parameter ID	Default Value	GUI Value Range	Actual Value Range	Unit	MML Command	NE
sInfoUpdFlag		FF, ON	F, ON	e	OPERATORCFGPARA(Optional)	C
AvailCap	-	0~65535	0~65535000 step:1000	None	ADD CNNODE(Mandatory)	RNC
NNSfTmr	-	0~60	0~60	s	SET OPERATORCFGPARA(Optional)	RNC

NOTE

The **Default Value** column is valid for only the optional parameters.

The "-" symbol indicates no default value.

5 Reference Documents

The following lists the reference documents related to the feature:

1. 3GPP TS 23.236: Intra-domain connection of Radio Access Network (RAN) nodes to multiple Core Network (CN) nodes
2. 3GPP TS 25.875: Non Access Stratum (NAS) Node Selection Function
3. 3GPP TS 25.401: UTRAN Overall Description
4. 3GPP TS 25.410: UTRAN Iu Interface: General Aspects and Principles
5. 3GPP TS 25.413: UTRAN Iu Interface RANAP Signalling
6. 3GPP TS 25.331: Radio Resource Control (RRC)
7. Basic Feature Description of Huawei UMTS RAN11.0 V1.5
8. Optional Feature Description of Huawei UMTS RAN11.0 V1.5